Exam

Task 1

Electron beam of E=3 GeV is circulating in 12m perimeter ring (80% filled with bends). Estimate synchrotron radiation energy loss per turn and characteristic energy of the emitted photons.

Task 2

What laser intensity (in W/cm^2) would correspond to normalized vector potential a_0=2, and what are the maximum values of the electric and magnetic field in the laser wave, for a Ti:Sapphire laser. What is the relativistic Lorentz factor of electrons oscillating in the field of such a laser? What is the radiation pressure of this laser on a square planar foil that has a reflectivity of 80%?

Task 3

Assume that plasma density is 1E18 cm-3. Laser light of which wavelength will still penetrate such plasma? Also, estimate the corresponding plasma frequency. What is the refractive index of this plasma density for a Ti:Sapphire laser and a CO2 laser ? What is the group velocity of these lasers in the given plasma density?

Task 4

Estimate maximum field of an undulator with period 15 mm, to be used with 1 GeV electron beam and assuming that the undulator parameter K should be equal to 1.

Task 5

Suggest and describe a possible further improvement of design or parameters of the compact light source (Project 3), designed by the team, aiming at either improvement of performance (such as photon flux) or improving technical feasibility of the design. If possible, refer in your suggestion to inventive principles of TRIZ (or AS-TRIZ).